



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
WASHINGTON D.C. 20460**

**OFFICE OF THE ADMINISTRATOR  
SCIENCE ADVISORY BOARD**

XXXX XX, 2011

EPA-SAB-11-xxx

The Honorable Lisa P. Jackson  
Administrator  
U.S. Environmental Protection Agency  
1200 Pennsylvania Avenue, N.W.  
Washington, D.C. 20460

Subject: Office of Research and Development (ORD) New Strategic Research  
Directions: A Joint Report of the Science Advisory Board (SAB) and  
ORD Board of Scientific Councilors (BOSC)

Dear Administrator Jackson:

The EPA Science Advisory Board (SAB) and Executive Committee of ORD's Board of Scientific Councilors (BOSC) held their first joint meeting on June 29-30, 2011. The meeting offered an extraordinary opportunity to discuss ORD's new strategic research plans and to provide early input for ORD research planned for FY 2012 and beyond.

ORD has realigned its research from 13 project areas, defined by specific problems and media type, into four integrated programs (Air, Climate and Energy; Safe and Sustainable Water Resources; Sustainable and Healthy Communities; and Chemical Safety for Sustainability) related to your major priorities plus two cross-cutting areas (Human Health Risk Assessment and Homeland Security Research). This consolidation and realignment of programs reflects an emphasis on integrated transdisciplinary research, multi-pollutant exposures and sustainability. ORD requested a joint meeting of the SAB, which traditionally has provided advice on ORD strategic research directions, and the ORD's Board of Scientific Councilors, which has traditionally focused on ORD's implementation of its research programs, to get the benefit of their combined advice at an early stage in the process of defining research plans.

Both the SAB and the BOSC enthusiastically support ORD's consolidation of research programs. Consolidation will bring efficiencies and promote a systems approach to sustainability as an overarching framework for ORD research. Consolidation of ORD research programs and adoption of such a systems approach to sustainability are bold and necessary steps. Environmental and public health protection requires a deep understanding of environmental problems and an ability to translate problem identification and understanding into information that can empower solutions. EPA science is likely to resonate with the public if it is framed in terms of actual environmental systems, rather than traditional scientific disciplines, and if ORD

1 can communicate how its science can be linked to preventing and solving environmental  
2 problems.

3  
4 The SAB and BOSC are impressed with ORD's progress in conceptualizing the new research  
5 programs. There has been an impressive increase in transdisciplinary collaboration as well as  
6 coordination across ORD programs with the restructuring. ORD has involved regional and  
7 program office stakeholders in the design of the new programs. Program and regional support for  
8 ORD's new approaches is evident. Although one of the research programs, the Safe and  
9 Sustainable Water Resources program, has made more progress than others in formulating  
10 problems in systems terms and in articulating clearly the science activities to be undertaken to  
11 explore and address those problems, the ORD research frameworks, over time and taken  
12 together, will help the EPA build a culture and environmental programs to promote  
13 sustainability. Finally, ORD's efforts to foster innovative research are notable. The EPA has  
14 thought seriously and operationally about ways to energize the creativity of ORD scientists and  
15 has begun to explore ways of enhancing innovation as a fundamental part of ORD programs.

16  
17 The success of ORD's new research directions, of course, will depend upon implementation.  
18 Planned research must be supported by the financial and human resources needed. We  
19 recommend that the draft research frameworks each transparently describe the research goals and  
20 activities that are within the scope of ORD resources or active collaboration with external  
21 research partners. ORD must plan for the resources needed to sustain the communication,  
22 stakeholder involvement, and integrated transdisciplinary collaboration that will be essential to  
23 its new approach to research. The SAB and BOSC also underscore that all the systems of interest  
24 to EPA include human behavior. Research on relevant aspects of human behavior is crucial to  
25 understanding the systems and implementing solutions or programs that follow from them.  
26 Increased emphasis on social, behavioral and decision sciences within ORD is needed for the  
27 new research programs to be successful. The SAB and BOSC recommend that ORD take  
28 specific steps to enhance its expertise and research in these areas.

29  
30 The SAB and BOSC seek continued dialogue with ORD as part of their mission to advice on the  
31 science and research supporting EPA's decisions. We look forward to any comments you have at  
32 this time on these reflections on ORD's new research directions.

33  
34 Sincerely,

35  
36  
37  
38  
39 Dr. Deborah L. Swackhamer  
40 Chair  
41 Science Advisory Board

Dr. Martin Philbert  
Chair  
ORD Board of Scientific Counselors

## NOTICE

This report has been written as part of the activities of the EPA Science Advisory Board (SAB), a public advisory group providing extramural scientific information and advice to the Administrator and other officials of the Environmental Protection Agency. The SAB is structured to provide balanced, expert assessment of scientific matters related to problems facing the Agency. This report has not been reviewed for approval by the Agency, and, hence, the contents of this report do not necessarily represent the views and policies of the Environmental Protection Agency, nor of other agencies in the Executive Branch of the Federal government. Mention of trade names of commercial products does not constitute a recommendation for use. Reports of the SAB are posted on the EPA website at <http://www.epa.gov/sab>.

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22 **Dr. Angela Nugent**, Designated Federal Officer, U.S. Environmental Protection Agency,  
23 Science Advisory Board (1400R), 1200 Pennsylvania Avenue, NW, Washington, DC, Phone:  
24 202-564-2218, Fax: 202-565-2098, (nugent.angela@epa.gov)

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16 U.S. Environmental Protection Agency  
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# ORD's New Strategic Research Directions: SAB and BOSC Advice

## 1. Introduction and overarching comments

### *Introduction*

On June 29-30, 2011, the EPA Science Advisory Board (SAB) and the EPA Office of Research and Development (ORD) Board of Scientific Counselors (BOSC) held their first joint meeting. At ORD's request, they discussed six draft research frameworks ORD had developed for its major research areas. ORD requested SAB and BOSC advice because it is restructuring its research programs for FY 2012 to better understand environmental problems and inform sustainable solutions to meet EPA's strategic goals. The restructured research program will be comprised of six program areas: Air, Climate, and Energy; Safe and Sustainable Water Resources; Sustainable and Healthy Communities; Chemical Safety for Sustainability; Human Health Risk Assessment; and Homeland Security. ORD had requested SAB and BOSC advice at an early stage in the process of defining strategic program directions to help ORD develop research plans to respond to EPA's strategic goals and high priority needs.

ORD requested the SAB and BOSC to address six charge questions for each of the major research areas:

- a. To what extent do the draft research frameworks describe EPA's National Program and Regional Offices strategic science priorities? How well do ORD's research programs align with those priorities? If resources allow, what are areas for increased emphasis? If resources decline, what areas might be appropriate for decreased emphasis?
- b. How can ORD enhance coordination among its research programs, and better ensure that they complement one another?
- c. How well do ORD's proposed research directions reflect its commitment to sustainably protecting human health and the environment?
- d. How do the six programs fit together as an integrated environmental research strategy, charged with informing decisions on the nation's most-critical environmental issues? Are these programs positioned to address the nation's highest priority, emerging environmental issues in the coming years?
- e. Based on Board members' familiarity with efforts in the broader scientific community, how well do ORD's research programs appear to catalyze and complement environmental science programs elsewhere? What suggestions do the members have for how EPA's research programs could

1 improve upon their leveraging with those of others?

- 2  
3 f. How does the SAB/BOSC view ORD's activities in stimulating innovative  
4 research and what other suggestions would the SAB/BOSC have to  
5 promote innovation in EPA research?  
6

7 ***Overarching comments***  
8

9 First, the SAB and BOSC strongly support ORD's consolidation of its research programs  
10 that correspond to the Administrator's priorities plus two mission-critical research  
11 programs (Human Health Risk Assessment and Homeland Security). The consolidation  
12 of research activities within large thematic areas oriented to systems thinking and  
13 problem solving has created possibilities for enhanced collaboration across ORD  
14 laboratories and centers and stimulated transdisciplinary research in ORD. This  
15 consolidation is positive and appropriate for an organization that is seeking to foster  
16 innovation and a nimble, flexible structure for research. Managed appropriately, these  
17 larger research programs will encourage ORD researchers to reach beyond potentially  
18 narrow disciplinary limits to formulate and conduct research that meets EPA's current  
19 and future high priority needs.  
20

21 Second, ORD requested advice both on how well its proposed research directions reflect  
22 its commitment to sustainably protecting human health and the environment *and* how  
23 well ORD's draft research frameworks describe and meet the strategic science priorities  
24 of EPA's national program and regional offices. As a research organization in a mission-  
25 oriented Agency, ORD must strike a balance between vision and pragmatism, or better  
26 yet, find ways to have pragmatic goals that align with a strategic vision. The concept of  
27 sustainability potentially has great power to guide and help communicate ORD research,  
28 but ORD's draft research frameworks were not equally successful in describing how  
29 ORD research relates to sustainability and how different research programs would serve  
30 regional and program needs. This variation is understandable, because different  
31 frameworks reflected research areas with different scopes and histories. The Safe and  
32 Sustainable Water Resources program has a natural focus on water systems, for example,  
33 while the Safe and Healthy Communities Program reflected a broad and novel  
34 combination of human health and ecosystem-related research.  
35

36 Ideally, each research framework would include sustainability explicitly in its research  
37 vision, invoke a common definition of sustainability shared across ORD, demonstrate  
38 clearly how planned research relates to the key components of sustainability (the  
39 environment, the economy, and society), and show how regional and program office  
40 science needs will be met. As noted in the recently released report, *Sustainability and the*  
41 *U.S. EPA* (National Research Council, 2011), it will take time and culture change for  
42 EPA to adopt sustainability as a core principle to inform decisions and actions.  
43

44 Transparency will be essential to introducing sustainability at EPA. ORD's research  
45 frameworks can advance EPA's adoption of sustainability as a core principle by more  
46 consistently and clearly describing where and how ORD research relates to sustainability.  
47 They also will need to more clearly identify legacy research that relates only minimally

1 or tangentially to sustainability as full components of ORD's new sustainability  
2 approach. The framework documents should be revised to more clearly describe the  
3 research goals and activities that can be accomplished by ORD within the scope of  
4 planned resources, both human and financial. Readers of each document should be able  
5 to understand from each framework the research questions that will be addressed, the  
6 types of ORD products that would be generated, the general time frame for that activity,  
7 and how the planned activities relate to sustainability and/or science priorities of National  
8 Program and Regional Offices.

10 Third, ORD must plan for the human resources needed for the ambitious research  
11 described in the draft frameworks. Transdisciplinary, systems-oriented research requires  
12 coordination within and across research teams and stakeholder involvement. Both these  
13 coordination activities are time-intensive efforts. Anticipating the resources and the  
14 expertise set needed for all the activities included in the research frameworks will be  
15 critical to their success. With an increased emphasis on "systems thinking," all the  
16 systems of interest to EPA include human behavior. Research on relevant aspects of  
17 human behavior is crucial to understanding the systems and implementing solutions or  
18 programs that follow from them. Increased emphasis on social, behavioral and decision  
19 sciences within ORD is needed for the new research programs to be successful. Although  
20 ORD did not request advice about how to enhance its capacity in these areas, the SAB  
21 and BOSC provide recommendations on this important topic in Section 3 of this report.

23 The body of this report provides responses to ORD charge questions that are relevant to  
24 all ORD's new research programs. Sections 2.1-2.5 provide responses specific to each  
25 major ORD research program.

### 27 *Alignment with regional and national program office needs*

29 The one-to-one mapping of ORD programs with the Administrator's priorities provides a  
30 structure for aligning and understanding research programs in terms of EPA's strategic  
31 goals. The SAB and BOSC commend ORD for involving regional and program offices as  
32 stakeholders in the development of the research frameworks. ORD should continue to  
33 actively involve these clients in implementation of ORD research programs and  
34 evaluation of research results.

### 36 *ORD internal coordination*

38 The readily apparent increase in the amount of communication among ORD's National  
39 Program Directors and Directors of Laboratories and Centers in the development of  
40 ORD's research frameworks is a very positive development. ORD should seek to expand  
41 formal mechanisms to promote networking among internal researchers to improve  
42 research coordination throughout the research process in the least time-intensive manner.  
43 Examples of such mechanisms might include "speed dating," use of social network  
44 technology, co-location of researchers and exchange programs. Directed Requests for  
45 Applications (RFAs) that require coordination of research projects across ORD research  
46 programs can also provide an incentive to ensure coordination.

1 Cross-cutting issues, such as environmental justice, that are a priority of the  
2 Administrator, should be explicitly identified, wherever appropriate, as part of such RFAs  
3 to foster coordination and advance the Administrator's goals.

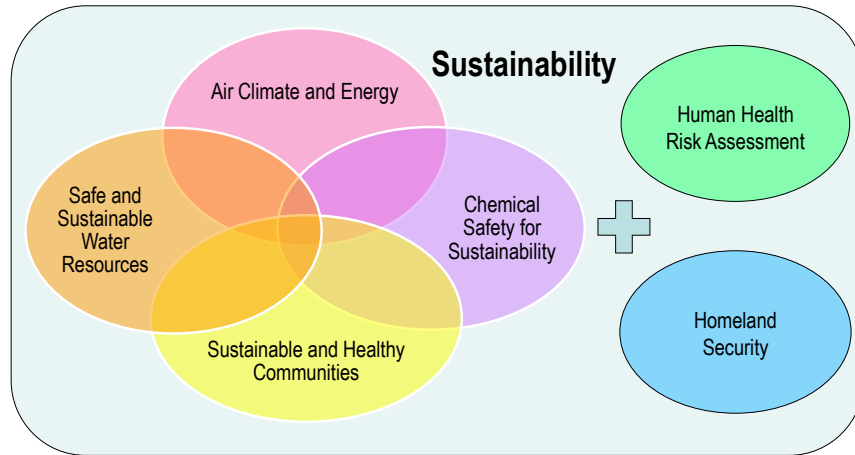
4  
5 For both intra-mural and extra-mural research, ORD should identify priority cross-  
6 program research topics such as nitrogen and climate as vehicles for research  
7 coordination and building of interdisciplinary culture. Additional cross-cutting research  
8 topics should be explored in the future, such as multiple stressors, measures of ecosystem  
9 function, ecosystem services, energy and green infrastructure. Interdisciplinary  
10 collaboration and research coordination across all areas could be strengthened by  
11 development of community of practice "core" teams in areas such as communication,  
12 decision tools and modeling that are engaged with all six ORD research programs.

13  
14 Initial planning meetings that help to frame research problems properly at the outset will  
15 enhance ORD program coordination. Internal and external stakeholders interested in or  
16 affected by ORD's research programs should participate in problem formulation. ORD  
17 scientists from other research programs should also be present to identify issues and  
18 opportunities for synergy across programs. Problem formulation that frames issues in  
19 terms of "systems thinking" and sustainability will foster increased coordination and  
20 proactive thinking to identify innovative approaches to prevent environmental problems  
21 before they occur. Social, behavioral and decision scientists provide expertise for  
22 problem formulation. Such experts can be especially useful in identifying opportunities  
23 for institutional flexibility and framing environmental problems in a larger social,  
24 economic, and institutional context.

25  
26 ORD should also support research teams to enhance coordination among research  
27 programs as research programs are implemented. It will take sustained effort to maintain  
28 communication and coordination beyond the research planning phase.

29  
30 As part of that ongoing coordination, ORD should identify its six research programs  
31 clearly (and not refer to them as four programs plus two cross-cutting areas). Three  
32 different conceptualizations of ORD research programs were presented graphically at the  
33 June 2011 SAB-BOSC meeting by the ORD Deputy Assistant Administrator for Science  
34 (Figure 1); the National Program Directors for the Safe and Sustainable Water and  
35 Sustainable and Healthy Communities programs (Figure 2); and the Chemical Safety for  
36 Sustainability draft research framework (Figure 3)

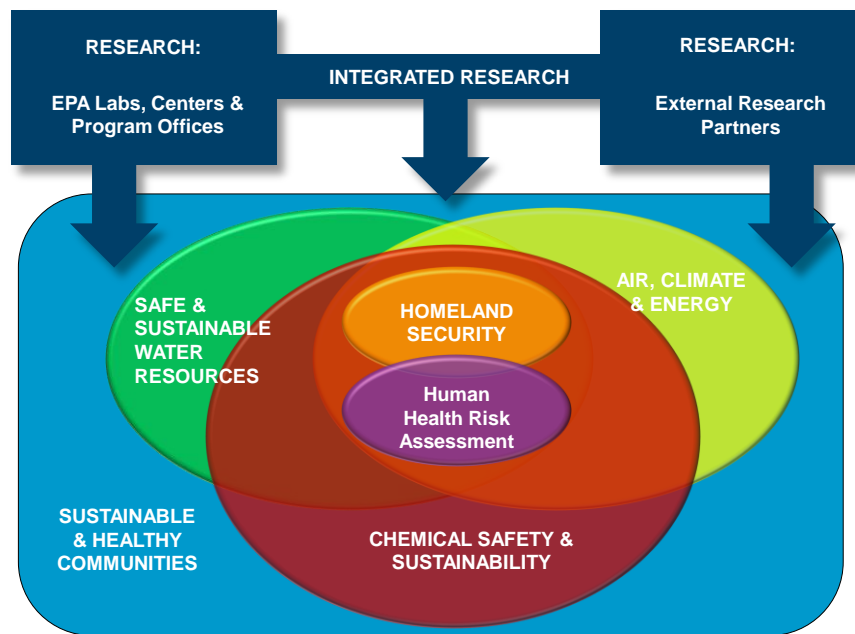
## Integrated ORD Research Programs



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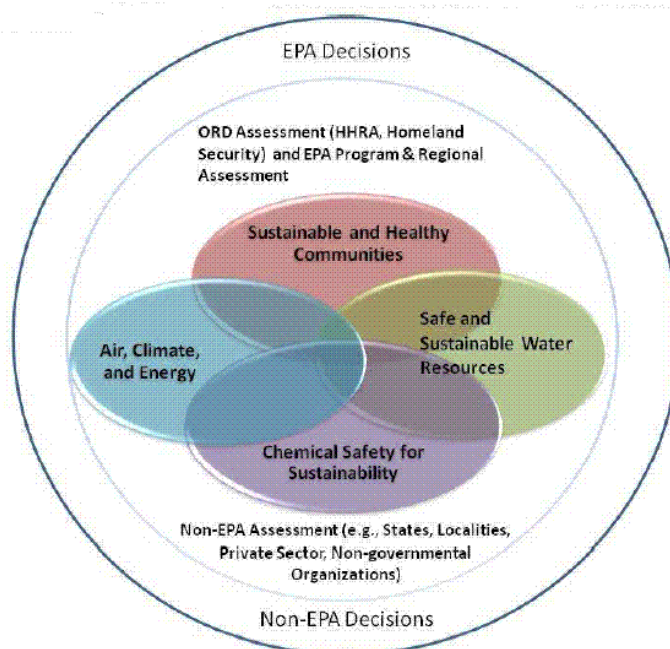
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**Figure 2: Slide provided by the ORD Deputy Assistant Administrator for Science**



1

**Figure 2 – Schematic used by the Safe and Sustainable Water and Sustainable and Health Communities Programs**



**Integrated EPA Research Programs Within EPA and Non-EPA Partner and Stakeholder Contexts**

**Figure 3 – Schematic used by the Chemical Safety for Sustainability Research Program**

It is important to use a consistent diagram to clearly communicate how ORD research programs inter-relate and how they fit within larger EPA and stakeholder science contexts. As noted in the draft Safe and Sustainable Water framework, “To provide scientific information and tools that advance environmental sustainability, the four new national program areas must contribute to and reinforce one another, and jointly work with decision makers both inside and outside EPA.” Including a common diagram illustrating how ORD research programs inter-relate and relate to external science would be useful to include in all ORD research frameworks.

In addition, such a diagram is also needed to clarify the role of the Sustainable and Healthy Communities program as an integrating force within ORD. As the research program with the largest proposed investment and a holistic, systems perspective on human health and ecosystem protection, should it be an overarching program that other programs feed into or a research program relatively separate and co-equal with other ORD research programs? A diagram that clarifies the explicit role of the Sustainable and Healthy Community Program in problem formulation overall for ORD research; its role in evaluation of ORD research products, as they are used by communities; and its role integrating ORD research at community levels would help to better explain the unique aspects of the Sustainable and Healthy Communities program and enhance coordination across ORD programs.



## *Sustainability*

As noted in the general comments above, the SAB and BOSC recommend that ORD revise each research framework to include sustainability explicitly in its research vision, invoke a definition of sustainability shared across ORD, and demonstrate clearly how planned research relates to the key components of sustainability (the environment, the economy, and society). It may be appropriate for the shared definition to be consistent with the 2011 NRC report or to explain why ORD has chosen a definition different from the language the NRC chose. The NRC derived its definition from language in Executive Order 13514, which established the National Environmental Policy Act (NEPA). The NRC defined sustainability as:

“to create and maintain conditions, under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations” (NEPA[1969]; E. O.13514[2009]4).

ORD leads EPA in efforts to build a sustainability-oriented culture within EPA. Sections 2.1-2.5 of this report provide additional detail about how different frameworks might be revised to better reflect ORD’s commitment to sustainability. Clear and consistent use of the term “sustainability” in each research framework and clear linkages of the concept to research programs as they develop will require careful, continued attention. It would be helpful for all research frameworks to include a list of definitions of key terms that would be consistent across ORD’s programs.

If sustainability is ORD’s goal, it will be useful to develop sustainability metrics for each research program to gauge whether research helps attain sustainability goals, even if such metrics only provide early markers of these long-term goals. Without metrics, resources may not be wisely allocated and the long-term goals missed completely. This issue is complex and worthy of research in itself, because there has been a historical “disconnect” between the ideal of sustainability and the practice of regulating human health and the environment. Sustainability metrics and how they articulate with regulations would help to better define sustainability in a realigned ORD and how to achieve it.

Finally, for ORD to reflect its commitment to sustainably protecting human health and the environment, it must show leadership in two areas of research. First, ecological research must be a strong priority for ORD. Sustainability depends on understanding and protecting the ecosystems on which human life and all life on earth depends. Ecosystem structure, function, and services are an integral part of sustainability. Section 2.4 below discusses this topic in more detail. Second, because sustainability involves policy and social dimensions, explicitly integrating social, behavioral, and decision science research into ORD’s research frameworks is important to demonstrate commitment to the sustainability theme.

1     ***Capacity to address current and future critical environmental issues***

2  
3     ORD's involvement of stakeholders and other federal partners in research planning  
4     provides a good mechanism to identify environmental issues and prioritize among them.  
5     Additional formal mechanisms for peer review and regular consultation with the SAB  
6     and BOSC and other external groups will help alert ORD to emerging issues. It may also  
7     be helpful for ORD to form an internal committee of cross-program futurists, with  
8     representatives from each research program to identify emerging issues and consult with  
9     the SAB, BOSC and other EPA groups and external stakeholders.

10  
11    The most effective way for ORD to build capacity to develop responses to emerging  
12    environmental issues is to evaluate how EPA has responded to emerging science topics  
13    such as nanomaterials, the Deepwater Horizon oil spill, hydraulic fracturing or natural  
14    disasters. EPA could then identify which processes worked to anticipate those topics and  
15    to develop the needed science and which processes were not effective. Emerging  
16    environmental issues are not always predictable. Therefore, the Agency needs to be  
17    “nimble” in its research and assessment capacities to address these unpredictable issues  
18    and must strengthen its human resources and organization to provide maximum  
19    resilience. Being nimble requires that the workforce be willing and able to undertake new  
20    research tasks, work in teams, and work in new ways. ORD's re-aligned structure may  
21    enhance this by allowing a more free flow of personnel across programs to provide the  
22    expertise where it is needed in a timely fashion. Workforce “continuing education” is also  
23    a critical issue. The development of programs (visiting scholars, post-doctoral programs,  
24    or other “collaborative practices” with outside scientists) designed to develop and  
25    maintain the appropriate skill-sets within the Agency are important.

26  
27    One area where ORD can increase its capacity to address future critical environmental  
28    issues is to explore the opportunities offered by “Environomics” (i.e., the computational  
29    analysis of complex environmental data) to develop understanding of environmental  
30    phenomena through enhanced monitoring, technologies for understanding data-rich  
31    environments, data mining and data simulation. There may be new opportunities for EPA  
32    to understand the environment and pair this enhanced understanding with chemical  
33    forecasting that can be useful for predicting public health and environmental impacts.  
34    Such an approach could potentially provide new, creative and innovative approaches for  
35    preventing and addressing the causes of complex environmental problems such as Gulf  
36    hypoxia and averting water quantity and water quality problems likely to arise from  
37    current exploitation of groundwater resources. Similarly, such research could help EPA  
38    attain a possible future where EPA could work with the “exposome” (i.e., all cumulative  
39    risks to people) and match this “exposome” information with genetic and epigenetic  
40    profiles to understand and manage environmental risks.

41  
42    ***Ability to catalyze and complement environmental science programs outside EPA***

43  
44    Collaboration with other federal agencies and European partners is increasingly important  
45    for ORD because of the ambitious scope of ORD's new research frameworks and the  
46    limitations of EPA's budget. The Chemical Safety for Sustainability program stood out as  
47    a model for its significant efforts to develop collaborative and complementary efforts

1 with other federal agencies (i.e., Tox21) and European partners (e.g., the Joint Research  
2 Center in Ispra, Italy). This level of effort and coordination needs to be extended to other  
3 ORD research endeavors. ORD should actively explore formal and creative informal  
4 ways of undertaking inter-agency and international collaboration. Examples of such  
5 mechanisms include social network technology, co-location of researchers from different  
6 agencies and exchange programs among agencies.

8 ORD should continuously stimulate interactions between EPA and outside scientists. One  
9 mechanism could involve a program of roundtables with outside experts. Visiting  
10 scientists could be brought into the laboratories and centers for one year to cross-fertilize  
11 ideas on how to operationalize sustainability as an organizing principle at EPA.

13 To ensure that ORD's new research directions develop deep roots, the office should  
14 develop a mentoring and leadership development program. There will be a need to advise  
15 young researchers on their projects, publications and career objectives and to foster the  
16 culture of sustainability-related research at ORD. This internal human resource effort  
17 should complement a strategy to recruit young scientists with expertise and interest in  
18 sustainability science.

20 ORD should set defined goals to catalyze and complement environmental science  
21 programs outside EPA and seek BOSC review and assessment related to this topic every  
22 two years.

## 24 ***Innovation***

26 ORD's efforts to foster innovative research are impressive. The Agency has thought  
27 seriously and operationally about ways of energizing the creative nature of ORD  
28 scientists and has begun to explore ways of enhancing innovation as a fundamental part  
29 of ORD programs. Creating an ORD Chief Innovation Officer position is a bold, positive  
30 step, and the Pathfinder Innovation Program is a creative and important initiative. New  
31 approaches, such as "crowdsourcing," to meet research challenges can be appropriate  
32 ways to tap creative research.

34 To further promote innovative research at EPA, ORD should develop metrics to evaluate  
35 programs such as Pathfinder. ORD should be able to define "failure" and "success" as  
36 part of the development of such programs and reach agreement on an acceptable "failure"  
37 rate for innovation efforts. ORD should also develop and maintain a mentoring and  
38 scientist development program that encourages creative and innovative approaches, as  
39 well as a reward system, perhaps similar to the Scientific and Technological  
40 Achievements Award program to recognize successful researchers who "think outside the  
41 box." ORD should also look for opportunities to simulate innovative research in new  
42 fields related to the social, behavioral, and decision sciences.

44 EPA also has a role in promoting innovative environmental research outside EPA and,  
45 indeed, in leading the country toward the adoption of more sustainable practices.  
46 Innovation could be enhanced by finding ways of making EPA data easily accessible to  
47 the outside community of scientists who could use these data in creative ways or by

1 emphasizing innovation in EPA's extramural grant programs. There are thousands of  
2 scientists at universities, colleges and research institutions whose expertise can be  
3 solicited through extramural research support, workshops and brainstorming sessions that  
4 bring EPA scientists together with the external science community. Highly innovative  
5 external scientists can serve as reviewers for Pathfinder proposals and projects. Consortia  
6 projects (extramural scientists working very closely with Agency scientists on a project)  
7 can help build an even greater resource of expertise and innovation throughout the  
8 country and not just at EPA. ORD might also consider a multi-agency Pathfinder  
9 Innovation Project that would tap the expertise of environmental scientists from other  
10 federal agencies. EPA needs to drive innovative research within the external scientific  
11 community.

12  
13 Innovation often comes through the coming together of scientists from different fields, as  
14 well as scientists from different organizations (pure academic research, industry, non-  
15 governmental organizations, other federal agencies, state and local governments). Thus,  
16 symposia where the Agency can present proposed approaches and ask for feedback from  
17 outside the Agency would be extremely helpful.

#### 18 19 *Social, behavioral and decision sciences*

20  
21 The SAB and BOSC underscore that all the systems of interest to EPA include human  
22 behavior. Research on relevant aspects of human behavior is crucial to understanding the  
23 systems and implementing solutions or programs that follow from them. Increased  
24 emphasis on social, behavioral and decision sciences within ORD is needed for the new  
25 research programs to be successful. The SAB and BOSC took the initiative to develop  
26 Section 3 of this report to outline ways ORD can expand its capabilities in these  
27 important scientific disciplines.

## 2. ADVICE SPECIFIC TO ORD'S MAJOR RESEARCH PROGRAMS

### 2.1. Air, Climate and Energy

#### *Background*

ORD is reorganizing this research program around sustainability and environmental solutions. The draft research framework identified the following problem statement:

Protecting human health and the environment from the effects of air pollution and climate change, while sustainably meeting the demands of a growing population and economy is critical to the well-being of the Nation and the world. As we explore solutions to prevent and reduce emissions, we are challenged by uncertainties surrounding the complex interplay between air quality, a changing climate, and a changing energy landscape, and the subsequent human health and ecological effects attributed to exposure to an evolving array of pollutants in the atmosphere.

The draft framework identified the following problems as the focus of attention:

- The multipollutant nature of air pollution in order to develop effective air quality strategies;
- The impacts of climate change and the interactions between adaptation and mitigation;
- The human health and environmental impacts of current and future energy options;
- The populations most susceptible to poor air quality and the populations and ecosystems most vulnerable to climate change;
- The expanding and contracting scales of environmental problems that range from global to local; and,
- The social, behavioral, and economic factors that influence the effectiveness of air quality and climate policies.

The vision articulate in the framework is:

To provide cutting-edge scientific information and tools to support EPA's strategic goals to take action on climate change and improve air quality.

The draft framework proposed that ORD would provide the policy-relevant research needed by EPA partners to assess impacts, prevent and reduce emissions, and respond to changes in climate and air policy.

1 ***General observations:***

2  
3 The vision for the Air, Climate and Energy program includes sustainability as a paradigm  
4 for research, but there exists a fundamental disconnect between sustainability and the  
5 legislative mandates of the Clean Air Act. ORD should address clearly how it will  
6 integrate the two needs for research and how it will trade off between them. This tension  
7 will grow and may increasingly need to be addressed if EPA's budget is constrained. One  
8 possibility is to build on EPA's historic strengths. Air quality monitoring has been a  
9 major strength of ORD in the past and it contains a unique opportunity for changing the  
10 future. Sensor development and reporting networks opportunities are ripe if research is  
11 undertaken wisely. In the past, the EPA has conducted monitoring for the sake of  
12 compliance. EPA might consider shifting or using some of that monitoring for decision-  
13 making and hypothesis testing as well.

14  
15 In the climate arena, biofuels is one area where EPA has a mandate to prepare an annual  
16 report to Congress on green house gas effects from biofuels and the Renewable Fuel  
17 Standard. Although EPA has little authority related to energy and little authority on  
18 climate other than that provided through the Supreme Court ruling and the Endangerment  
19 Finding, the lack of legislative authority and regulatory responsibilities could free ORD  
20 to pursue unfettered and innovative, creative research that may support voluntary and/or  
21 information-based programs.

22  
23 ***Alignment with regional and national program office needs.***

24  
25 In general, the draft framework reflects the strategic science priorities of programs and  
26 regions. The SAB and BOSC support the increased emphasis on energy choices and the  
27 nexus between air, climate, and water. A focus on multi-pollutants also integrates well  
28 with this emphasis. Research directed at single pollutants is being restructured within the  
29 multipollutant framework and that is appropriate. The framework should be revised to  
30 describe more clearly where multi-pollutant efforts were under way and the sequencing  
31 of different multi-pollutant activities.

32  
33 Despite its strengths, however, the framework could better describe the transdisciplinary  
34 nature of the research needed. More emphasis is needed on climate change research to  
35 reduce greenhouse gas emissions, both from a technological standpoint (like carbon  
36 sequestration) and also from a social and behavioral standpoint (how to get the desired  
37 environmental behavior from people and industry without mandates or command-and-  
38 control legislation). Research in the social, behavioral and decision sciences is needed on  
39 how people come to understand climate change, their risk perceptions and what motivates  
40 them to take action. How do these attitudes develop? People value present goods far more  
41 than future goods (discounting). What would make technologies be perceived as being  
42 viable? How do we ensure adoption of sustainable technologies? In addition, the  
43 intersection of science and policy should be a distinct research area within the Air,  
44 Climate and Energy program. This topic has been a lively focus of research for the past  
45 ten years (Mitchell et al 2006; Clark et al, in press; Sarewitz & Pielke 2007; Graffy 2008;  
46 Weible et al 2010). The example of the Intergovernmental Program on Climate Change,

1 among others, has stimulated research on the relationship of policy to science that could  
2 be useful to ORD.

3  
4 It will be important for the Air, Climate and Energy program to regularly check that  
5 research is aligned with regional and national program office needs. Research should  
6 begin with the question in mind, clearly stated and properly framed. The National  
7 Research Council “Silver Book,” *Science and Decisions* (National Research Council  
8 2009) provides a good guide in this respect. ORD should conduct regular synthesis  
9 activities to determine whether the research conducted has solved the problem and to  
10 identify additional knowledge gaps. In this effort, ORD should formulate the question  
11 (hypothesis) clearly and then research its every aspect holistically. One example might  
12 be: “black carbon should be the first pollutant to be regulated for overall Air, Climate and  
13 Energy program effectiveness including air quality/human health, climate change  
14 mitigation, and energy choices.” Appropriately, programs that have fulfilled their original  
15 objectives, like the near road program, leave room for other program areas to grow, like  
16 biomass. Some modeling exercises like source apportionment may be ready for decreased  
17 emphasis. Biomass could be emphasized for a period, and then be sunsetted. However,  
18 ORD synthesis activities could help illuminate unintended consequences as when  
19 biomass programs result in wood burning in a school boiler. Smoke exposure to children  
20 presents potential hazards that need to be examined.

#### 21 22 ***ORD internal coordination.***

23  
24 The Air, Climate and Energy program is closely related to the Sustainable and Healthy  
25 Communities and the Safe and Sustainable Water Resources research programs.  
26 Integrated assessments, driven by particular problems at the community, regional or  
27 national levels can be used to bring them together. Addressing problems related to  
28 climate change or water quantity may provide useful foci for assessments.

#### 29 30 ***Sustainability.***

31  
32 ORD should reference sustainability as a new paradigm for driving research in the Air,  
33 Climate and Energy framework. The vision statement for this research program as well as  
34 the problem statement should explicitly reference sustainability. The framework should  
35 explicitly address the possible “disconnect” between the ideal of sustainability and the  
36 practice of regulating human health and the environment, as required by the Clean Air  
37 Act. Sustainability metrics and how they articulate with regulations would help to better  
38 define sustainability in a realigned ORD and how to achieve sustainability. The SAB and  
39 BOSC recommend that ORD undertake research to define the benefits of moving from a  
40 more technology-based regulatory system to a performance-based regulatory system that  
41 “incentivized” sustainable solutions. As an example, one engineering innovation that  
42 might be considered is smart metering to encourage energy and water conservation;  
43 meters could be read in dollars saved in addition to kilowatts per hour. This approach  
44 may result in ancillary benefits of decreasing the cost of regulations to the regulated  
45 community and stimulating innovation. ORD can help EPA change the paradigm for  
46 environmental protection through identifying sustainable alternatives for risk managers’  
47 consideration. ORD should expand its current portfolio to help decision makers identify

1 and understand decision options related to sustainability. ORD could design and analyze  
2 scenarios related to changing air quality and different strategies for adapting to climate  
3 change. Any adaptation strategy will almost certainly be accompanied by environmental  
4 consequences that might be the focus of future research.

5  
6 ORD should consider programs to sponsor senior academic researchers for one-year  
7 visiting sabbaticals to seek their suggestions about how to transform the Air, Climate and  
8 Energy program into a program fully integrating sustainability.

9  
10 ***Capacity to address current and future critical environmental issues.***

11  
12 ORD's six research programs fit together and offer the possibility of addressing  
13 environmental issues that go beyond EPA's direct statutory mandates. The appendix to  
14 the draft Air, Climate and Energy draft framework articulates science questions and areas  
15 of integration within the research program and across ORD programs. Cross-cutting  
16 issues such as nutrients (i.e., reactive nitrogen) and climate change are highlighted the  
17 discussion. This design provides an effective roadmap for current and future critical  
18 issues and collaboration across ORD research programs. The appendix could even be  
19 more effective if it were extended to include collaboration with other key research  
20 partners, such as the Department of Energy.

21  
22 ***Innovation.***

23  
24 The Air, Climate and Energy program should encourage and stimulate relevant  
25 behavioral, social, cognitive and decision research both within the Agency and  
26 extramurally. As an example, research is needed on how to persuade people to change  
27 their behaviors regarding energy use. Examples include being receptive to smart meters,  
28 converting to compact fluorescent bulbs, buying higher mileage cars, etc. There is a huge  
29 amount of basic research to be conducted on the psychology of persuasion, on the  
30 subjective time-discounting factors that affect people's willingness to spend resources  
31 now for future gains and on risk communication. The SAB and BOSC recommends that  
32 the Air, Climate and Energy program bring in a few senior behavioral, social, cognitive,  
33 and decision science experts for one year visiting sabbaticals to cross-fertilize this new  
34 area.



## 2.2. Safe and Sustainable Water Resources

### *Background*

ORD has restructured its historical Drinking Water and Water Quality research programs into a single research program called Safe and Sustainable Water Resources. The new program strives “to develop sustainable solutions to 21st century water resource problems by integrating research on social, environmental, and economic outcomes to provide lasting solutions.” The draft research framework identified the following problem statement:

Increasing demands for sources of clean water, combined with changing land use practices, growth, aging infrastructure, and climate change and variability, pose significant threats to our Nation's water resources. Failure to manage our Nation's waters in an integrated, sustainable manner will limit economic prosperity and jeopardize both human and aquatic ecosystem health.

The draft framework explicitly identified two major challenges:

1. Provide the best science in a timely manner to allow faster, smarter management decisions on our existing problems; and
2. Get our science out in front of tomorrow's problems by developing and applying new approaches that better inform and guide environmentally sustainable behavior.

Two research themes are identified:

Research Theme 1 – Sustainable Water Resources: Ensure safe and sustainable water quality and availability to protect human and ecosystem health by integrating social, economic and environmental research for use in protecting and restoring water resources and their designated uses (e.g., drinking water, aquatic life, recreation, industrial processes, and other designated uses) on a watershed scale.

Research Theme 2 –Sustainable Water Infrastructure Systems: Ensure the sustainability of critical water resources using systems-integrated water resource management where the natural, green and built water infrastructure is capable of producing, storing and delivering safe and high-quality drinking water, and providing transport and use-specific treatment of wastewater and storm water.

The framework articulates the vision for this research program as follows:

Safe and Sustainable Water Resources uses an integrated, systems approach to research for the identification and development of the

1 scientific, technological and behavioral innovations needed to ensure clean  
2 and adequate and equitable supplies of water that support human well-  
3 being and resilient aquatic ecosystems.

4  
5 ***Alignment with regional and national program office needs.***  
6

7 The Safe and Sustainable Water Resources draft framework effectively describes the  
8 alignment of ORD's research with regional and national strategic goals. It also describes  
9 an appropriate prioritization process for identification of research focus areas. The  
10 prioritization process was notable for its engagement with a wide range of internal and  
11 external stakeholders. It will be important for this research program to continue to engage  
12 a wide range of stakeholder groups, including EPA programs and regions, as research  
13 activities develop. If budget cuts require future reductions, the prioritization process now  
14 in place should enable determination of the highest priority needs and activities that can  
15 be deferred or cut.

16  
17 The integration of the drinking water and water quality research programs is a very  
18 positive development and will provide important new synergies especially with respect to  
19 water treatment technologies relevant to drinking water, wastewater, and storm water;  
20 evaluation of microbial risks; and evaluation of aquifer storage and recovery.

21  
22 ***ORD internal coordination***  
23

24 The framework includes a section describing how the research program is designed  
25 within the context of ORD's restructured research programs. As part of that description,  
26 the Safe and Sustainable Water Resources draft framework contains a diagram  
27 reproduced as Figure 2 in this report (page 5). This figure provides an effective way to  
28 communicate how the research program inter-relates with ORD science and science  
29 generated outside ORD.

30  
31 ***Sustainability.***  
32

33 The Safe and Sustainable Water research topics were clearly formulated with the  
34 sustainability theme as guide. The framework provides a useful list of definitions that  
35 explain what is meant by sustainability and a "sustainable solution."

36  
37 ***Ability to catalyze and complement environmental science programs outside EPA.***  
38

39 The draft framework provides an excellent, detailed description of research needs,  
40 objectives and science questions. The description identifies where the science activities of  
41 EPA's partners complement ORD's efforts and where collaboration with EPA is needed  
42 to stimulate partner's research on topics of importance to EPA.

43  
44 ORD should evaluate existing mechanisms for inter-agency collaboration and build on  
45 them to maximize the potential to catalyze and complement environmental science  
46 programs outside EPA. Programs such as the Strategic Environmental Research and  
47 Development Program, the Food Emergency Response Network, the Chesapeake Bay

1 Program and a variety of programs created by U.S. Department of Agriculture's Natural  
2 Resource Conservation Service (e.g., the Mississippi River Healthy Basins Initiative,  
3 rural programs for small communities, animal feedlot management programs) offer  
4 opportunities to learn from and build upon. Such mechanisms can be used to promote  
5 networking with external researchers.

## 6 7 ***Innovation***

8  
9 The draft framework identifies opportunities to use the Science to Achieve Results  
10 (STAR) grant program to support technical development and innovation goals. Specific  
11 detail is provided within the overall context of objectives and science questions.  
12 Innovative technologies are especially important to the water infrastructure theme. The  
13 Small Business Innovation Research program may be a resource for this particular area.

## 14 15 ***Social, behavioral and decision sciences.***

16  
17 Social science issues permeate all of the priority research topics for the Safe and  
18 Sustainable Water Research program. Social science research should be integrated in all  
19 of the programs in explicit ways. Section 3 of this report provides more detail on the  
20 types of science and research that might be most useful and how ORD might undertake or  
21 collaborate to obtain the science and research needed.  
22

## 2.3. Homeland Security

### *Background*

ORD's Homeland Security Research Program has a focused mission and did not provide a draft research framework that included a "problem statement" or "vision statement." The draft framework described the mission of the program in this way: "to conduct research resulting in science and technology products that increase the Agency's capability to meet its homeland security responsibilities, thereby assisting communities' build their resilience. The program's goal is to plan, execute and produce these products in close concert with our Agency partners so that the results of this program are used by these partners in implementing their homeland security programs. A secondary goal of the program is to design research and its products so that they address natural and inadvertent disasters to the greatest extent possible."

The research framework identified five major themes:

- A. Research to Help Protect Water Infrastructure against Attacks
- B. Research to Improve Detection of Contamination and Mitigation of Exposure in Water Systems
- C. Research to Improve Characterization of the Nature and Extent of Contamination
- D. Research to Improve Risk Assessments and Communication
- E. Research to Improve Cleanup of Contamination

### *Alignment with regional and national program office needs.*

The Homeland Security program aligns with program and regional strategic goals within the specific scope of the program's mission and the framework describes an effective prioritization process for identification of research focus areas. The Homeland Security program has developed effective ongoing engagements with numerous stakeholders and partners, including a formal program of continuous partner engagement. If budget cuts require effort reductions, the prioritization process now in place should enable determination of what can be cut while ensuring that the program continue to meet highest priority needs.

The Homeland Security Program is not as far along in developing its framework as the Safe and Sustainable Water Resources program.

Regions that experience disasters, natural or anthropogenic in origin, can help with identification of research needs for the Homeland Security Research Program in unique ways. The program is well positioned to address natural disasters and is doing so in some ways already. The program should consider expanding research and capabilities in relation to natural disasters. There appear to be important needs and opportunities in several areas, including climate change and adaptation.

1  
2 ***ORD internal coordination and ability to catalyze and complement environmental***  
3 ***science programs outside EPA.***  
4

5 The Homeland Security model of coordination within and outside the EPA can be a  
6 model for other areas. Within EPA, the program works with Agency clients to plan,  
7 implement and deliver useful science products. By the nature of its mission, the program  
8 must actively coordinate with the Department of Homeland Security, the Department of  
9 Defense, and the Centers for Disease Control and Prevention. ORD should evaluate these  
10 processes to develop lessons learned to apply to other ORD research programs.  
11

12 ***Sustainability.***  
13

14 The linkage of the Homeland Security research topics with sustainability is not  
15 transparent, but the overall program objective of helping communities become more  
16 resilient is the sustainability link. ORD should revise the research framework to explain  
17 this linkage more clearly.  
18

## 2.4. Safe and Healthy Communities

### *Background*

The draft research framework identified the following goal:

to inform and empower decision-makers to equitably weigh and integrate human health, socio-economic, environmental, and ecological factors into their decisions in a way that fosters community sustainability.

To achieve this goal SHC will provide information, approaches, and tools that will help decision-makers in communities and in federal, state and tribal regulatory and community-driven programs to more effectively and transparently assess current conditions in the built and natural environments, to evaluate the implications of alternative policies and management actions, and to identify indicators to measure results.

The draft framework identified the following problems as the focus of attention:

Current trends in population and the way we use of energy, food, and materials have created environmental threats to sustainability that include the erosion of critical ecosystem services and the compromised ability of the environment to tolerate increasing levels of pollution. While technological breakthroughs will likely continue to slow some negative environmental trends, we still face many challenging problems. Not only are human health and ecosystem services negatively affected by cumulative exposures to multiple toxic pollutants and a changing physical environment, these effects also have economic and social implications, such as resultant costs for health care, cost for technologies to replace some ecosystem services, and costs to enhance social justice, at scales ranging from local to international. Because of the increasing pressures on the environment, it is clear that future approaches to protecting human health and the environment will not support sustainability over the long term if they:

- Fail to adequately consider the inextricable link between our natural environment and human well-being, including economic and social aspects;
- Focus on regulating one energy or materials stream or chemical at a time, rather than on preventative strategies or strategies that optimize management of multiple chemical and energy streams in order to achieve the most environmentally beneficial, cost-effective and socially acceptable outcome; or
- Lead to unintended consequences, or fail to produce valuable co-benefits, because of a lack of systems thinking.

1 The draft framework identified three major themes:

2  
3 Theme 1: Working with communities to develop comprehensive approaches to  
4 become more sustainable.

5  
6 Theme 2: Developing decision analysis methods, tools, models, data, and metrics  
7 that support community sustainability.

8  
9 Theme 3: Targeting high-priority agency research, i.e., Contaminated Site  
10 Management and Restoration; Waste and Materials Management- Support for  
11 Regulations, Policy, and Guidance; Nitrogen- Support for Regulation;  
12 Environmental Justice Topic; Children’s Health; and the Report on the  
13 Environment.

14  
15 ***General comments.***

16  
17 The Sustainable and Health Communities research program is visionary; community-  
18 based outreach and interactions are essential to sustainability. The new research area  
19 frames environmental issues in positive terms and is not bound by narrow regulatory  
20 constraints. The program has the potential to catalyze public support for environmental  
21 protection and for the EPA. Several other aspects of the program also are unique: 1) it  
22 focuses on the local or community level (rather than on national-level issues) because it is  
23 place-based; 2) it takes a holistic, systems perspective; and 3) it focuses on stakeholder  
24 participation and collaboration. Because this program is novel and ambitious, it requires a  
25 great deal of new and challenging research on place-based environmental problems and  
26 social, behavioral, and decision science issues. ORD, however, does not currently have  
27 the required expertise, especially in social, behavioral and decision sciences.

28  
29 The SAB and BOSC understand the value of providing decision support for communities  
30 (“empowering” local decision making), but find that the draft framework does not clearly  
31 describe the decision-makers/stakeholders or discuss whether the objectives of decision-  
32 makers necessarily reflect community objectives. Essential questions regarding the  
33 definition of the relevant community and whether community objectives align with  
34 broader national objectives are not articulated, much less answered, in the document.

35  
36 The framework should articulate a clearer vision for ORD’s role in providing assistance  
37 to communities. Will ORD provide decision tools or technical support at some initial  
38 phase or will it be an active participant in implementing tools? ORD does not currently  
39 have experience or expertise in community-based implementation and will need to  
40 develop both if it intends to be active implementing environmental tools in communities.  
41 The framework should describe clear expectations for ORD’s planned community work,  
42 as well as an “exit strategy” so readers will understand how far ORD’s commitment to  
43 active engagement with communities goes.

44  
45 The nature and level of integration of research across the three themes within the  
46 Sustainable and Health Communities program is unclear. The three themes represent very  
47 different kinds of activities and include “cutting edge” research, as well as support of

1 “conventional” regulatory mandates. Theme 1 is the most innovative, but will receive less  
2 than ten percent of the program’s resources initially. EPA’s commitment to this novel  
3 activity must be robust and sustained for the program to take root and grow.

4  
5 Finally, the Sustainable and Healthy Communities program includes essentially all of the  
6 ecological research in ORD. As such, there is a need to support ecosystem science within  
7 this program. Ecosystem services and benefits are contained as one component, among  
8 others, in Theme 2 of the SHC Research Program. The draft framework contains no  
9 discussion of ecosystem science apart from ecosystem services and benefits. The science  
10 necessary to understand ecosystem services and benefits appears to be under-funded and  
11 under-emphasized in the proposed research structure.

12  
13 Ecosystem science, which has seen a continued decline over the past decade and has been  
14 reduced to only \$60 million, about ten percent of the ORD budget, is important for  
15 several reasons. Ecosystem science is vitally important for understanding how  
16 ecosystems function. From the perspective of EPA, ecological research is important for  
17 understanding ecological processes that underlie healthy ecosystems and the quality and  
18 quantity of the services offered by ecosystem to communities. In addition to  
19 understanding ecological processes, there is important ecological and social science  
20 research needed to translate ecological processes to ecosystem services, to analyze the  
21 benefits to the community of these services and to predict the changes in the provision of  
22 services that would result from various actions/policies/behaviors.

23  
24 Consequently, the SAB and BOSC recommend increased support for ecosystem research  
25 by ORD.

### 26 27 ***Alignment with regional and national program office needs.***

28  
29 The Sustainable and Health Communities program clearly reflects an effort to integrate  
30 the Administrator’s top priorities at the community level. Within the program, areas for  
31 increased emphasis might include children’s health; social, behavioral and decision  
32 science research; and epigenetics to provide markers of exposure to chemicals. Integrated  
33 transdisciplinary research and coordination across ORD programs should provide some  
34 efficiencies and ORD may identify areas for reduced emphasis, if it finds that other  
35 agencies’ environmental research programs can complement EPA’s research efforts.

### 36 37 ***ORD internal coordination.***

38  
39 The Sustainable and Health Communities program can serve an essential “coordinating”  
40 role for ORD by working with communities to define sustainability goals and framing  
41 problems in terms of a broad systems approach that reduces media-specific and  
42 disciplinary silos. One vision for the program is for it to use, test, and evaluate research  
43 products from other ORD programs and provide feedback to guide more focused research  
44 from those programs in the future. The program can help integrate environmental  
45 research and problem solving at the national and local levels. ORD should revise the draft  
46 framework for the Sustainable and Health Communities program to describe its role  
47 within ORD more clearly and consider some of the functions described above.



1  
2 ***Sustainability.***  
3

4 At a theoretical level, the Sustainable and Health Community program directly reflects  
5 ORD's commitment to sustainably protect public health and the environment. The SAB  
6 and BOSC's introductory general comments in this section, however, identify concerns  
7 about how this program will be operationalized at the community level and concerns  
8 about possible misalignment between local and national perspectives  
9

10 ***Capacity to address current and future critical environmental issues.***  
11

12 This visionary program potentially would have the capacity to address current and future  
13 critical environmental issues, but it will need to identify clearly where ORD will provide  
14 leadership and where it will play a supporting role in addressing issues. Success  
15 implementing activities related to Theme 1 depends on effective partnerships with other  
16 agencies and non-governmental organizations as they work with communities to address  
17 high priority issues.  
18

19 As noted above, the Sustainable and Health Communities program may not necessarily  
20 align with national priorities if goals of communities differ from national priorities.  
21

22 ***Ability to catalyze and complement environmental science programs outside EPA.***  
23

24 ORD's progress in adopting integrated transdisciplinary research is consistent with  
25 momentum elsewhere to pursue such integrated approaches. ORD has made a positive  
26 commitment to focus on ecosystem services and has developed important partnerships  
27 with other agencies and nongovernment organizations, but there are significant additional  
28 opportunities to work with other countries and international research organizations to  
29 advance ecosystem science and research and bring these results to EPA and local  
30 decision makers. CITATIONS?  
31

32 There are also opportunities to complement and leverage research with the Department of  
33 Energy and Department of Defense on site contamination and cleanup issues and to  
34 explore partnerships with non-governmental organizations that that work closely with  
35 communities.  
36

37 One area for focus is to develop effective mechanism for catalyzing, complementing and  
38 leveraging research in the social, behavioral and decision sciences. ORD should explore  
39 new opportunities to partner with the National Science Foundation to support extramural  
40 research in this area and to serve as a clearinghouse for community-level data and metrics  
41 related to sustainability (e.g., "urban metabolism").  
42

1   ***Innovation.***

2  
3   Community-based research offers a wide variety of new opportunities for innovation.  
4   ORD should promote opportunities for community-based data collection, monitoring and  
5   reporting, subject to standard quality controls. The Sustainable and Healthy Communities  
6   program would benefit from investments in related technological innovation, such as  
7   hand-held monitoring devices or mobile phone applications for collecting and  
8   transmitting environmental or public health data. Such new technologies would involve  
9   new ways to engage communities, which would be a focus of innovative social,  
10   behavioral and decision science research in itself.

11  
12   ***Social, behavioral and decision sciences.***

13  
14   The Sustainable and Healthy Communities program offers many potential roles for  
15   social, behavioral, and decision sciences. Such sciences can help with: 1) problem  
16   formulation, development of systems perspectives, and identification of alternatives; 2)  
17   engagement in participatory processes; 3) understanding behavior, behavioral responses  
18   and incentives; and 4) evaluation of alternative options and tradeoffs (e.g., impact  
19   analysis, benefit-cost analysis). Research on this topic is essential to the success of the  
20   program. ORD, however, does not currently have the capacity, internally or through  
21   external funding, to conduct this research.

22  
23   It will be important for ORD to explore how other agencies have engaged social,  
24   behavioral, and decision scientists (e.g., the Forest Service, U.S. Department of  
25   Agriculture in other programs, the Department of the Interior management of wildfire  
26   risks, the National Oceanic and Atmospheric Administration and the National Park  
27   Service) in place-based environmental decisions. Section 3 of this report describes how  
28   ORD might begin to develop a capability in these disciplines and access expertise outside  
29   EPA.  
30

## 2.5. Chemical Safety for Sustainability and Human Health Risk Assessment

### *Background*

Because these two research programs are so closely inter-related and such significant overlap, the SAB and BOSC provide the following consolidated discussion of ORD's draft frameworks for these programs.

The draft research framework for the Chemical Safety for Sustainability program identified the following problem statement:

Although chemicals are essential to modern life, we lack innovative, systematic, effective, and efficient approaches and tools to inform decisions that reduce the environmental and societal impact of chemicals while increasing economic value.

The vision articulated in the framework is:

EPA science will lead the sustainable development, use, and assessment of chemicals by developing and applying integrated chemical evaluation strategies and decision-support tools.

The Chemical Safety for Sustainability identified the following objectives:

- Creating tools that inform sustainable chemical/material design and use
- Developing methods for much faster screening and prioritizing
- Providing the scientific knowledge and tools to effectively understand real-world risks
- Developing assessment approaches that are tailored to specific decision contexts
- Considering where impacts may occur throughout a chemical's life cycle.

The draft framework for the Human Health Risk Assessment program identified the following problem statement:

Agency decisions must be based on defensible scientific evaluations of data relevant to assessing human health impacts. Currently, the demand for such assessments is not being fully met, particularly in terms of the number of existing and new chemicals in need of assessment, the types of risk characterization outputs needed to inform decision making, and the tools and data needed to support assessments.

The vision articulated in the framework is:

The Agency will generate timely, credible human health risk assessments to support all priority Agency risk management decisions, thereby enabling the Agency to better predict and prevent risk.

1 The four primary themes of the Human Health Risk Assessment program are:

- 2
- 3 • Integrated Risk Information System (IRIS) health hazard and dose-response
- 4 assessments;
- 5 • Integrated Science Assessments (ISA) of Criteria Air Pollutants;
- 6 • Community Risk and Technical Support for exposure and health assessments;
- 7 and
- 8 • Methods, models, and approaches to modernize risk assessment for the 21st
- 9 century

10

11 *Alignment with regional and national program office needs.*

12

13 In general, the draft framework documents were written from a theoretical perspective. The  
14 SAB and BOSC recommend that ORD revise the documents so they more clearly  
15 communicate the intended research and its strategic science priorities. The term “sustainable”  
16 and its derivative forms were used in different ways in the draft documents and there was little  
17 explanation of their meaning. It would be useful to define this term as it is employed in the  
18 documents. In addition, there were several other definitional problems, e.g., inherency, etc.,  
19 that have internal meaning at EPA but are not well known to others. The SAB and BOSC  
20 recommend that the terms employed in the framework documents be fully defined in concise,  
21 operational ways.

22

23 In revising the frameworks, EPA should include a short (~ three-page) executive summary that  
24 concisely identifies the key points in the document and a one-page text box/bubble diagram  
25 showing the research programs and their integration to clearly map the reorganization  
26 structure. The documents should more clearly convey the goal of integrating and coordinating  
27 research efforts as well as integrating the ways in which research priorities are developed and  
28 utilized.

29

30 It is evident that ORD is increasing efforts to collaborate internally across research programs  
31 and across program and regional offices and that the Chemical Safety for Sustainability  
32 program and the Human Health Risk Assessment program are aligned with regional and  
33 program office needs. Integration appears to be occurring in the way decisions are made  
34 concerning priority setting for ORD, as well as with the other Agency offices. ORD should  
35 identify more clearly where there are novel science products that will occur because of this  
36 coordination/alignment with regional and program office stakeholders and how these outputs  
37 would be measured. Clear metrics should be developed and deployed that track how this  
38 realignment changes the effectiveness of Agency actions so that these efforts can be evaluated.

39

40 Regarding prioritizing programs for increased or decreased emphasis, the SAB and BOSC  
41 recommend that ORD conduct analyses to help develop criteria for prioritization. Because it is  
42 difficult to predict specific issues for the future, it will be important to have a focused and well-  
43 defined path for strategic and rapid responses to emergencies is important. An analysis of the  
44 lessons learned from the 2010 Deepwater Horizon oil spill may help identify gaps. The Agency  
45 should conduct or support research to understand the public’s perception of uncertainty and  
46 risk assessment. Shedding some light on public attitudes and knowledge will enable the  
47 Agency to communicate the science more effectively. Social, behavioral, and decision science

1 research on this topic will help EPA identify how to address these factors. ORD should  
2 conduct analyses to help identify data gaps and prioritize research based on scheduled  
3 regulatory needs and other deadlines. Once such analyses are conducted, ORD should define  
4 clear short-term and long-term goals that can be measured with respect to what is to be  
5 achieved, the resources required and the timetable needed.

6  
7 The draft frameworks should better articulate social, behavioral, economic and decision  
8 science needs because these will assist the Agency in linking priorities to desired outcomes.  
9 This should be emphasized regardless of resources.

10  
11 Streamlining across agencies (e.g., Food and Drug Administration, U.S. Department of  
12 Agriculture; Food and Drug Administration; U.S. Geological Survey, National Institutes of  
13 Health; National Center for Toxicological Research; National Toxicology Program, and  
14 National Institutes of Health) should continue so that redundancy is minimized. Collaborative  
15 efforts need to be defined and the process transparent to minimize any tendency for  
16 compartmentalization (i.e., creating ‘turf lines’ or stovepipes). Collaborations such as Tox21  
17 will provide a better ability to leverage the resources of various agencies toward the EPA  
18 mission. This may require a common lexicon to be developed across agencies.

19  
20 Given EPA’s role as a leader in environmental research, extramural research is an important  
21 way for the Agency to tap the talent and enhance innovation at universities and other research  
22 institutions. Extramural research will increase the EPA’s ability to react flexibility to changes  
23 in priorities and associated personnel expertise needs. SAB and BOSC, however, note that  
24 extramural programs should not be undertaken in *lieu* of or at the expense of EPA’s intramural  
25 research activities. The frameworks should establish crisp and specific “goals and objectives”  
26 with milestones and timetable with respect to research to be executed and associated metrics  
27 (as well as anticipated costs; with respect to manpower and hard dollars).

#### 28 29 ***ORD internal coordination.***

30  
31 Directed extramural grants that require coordination of across ORD programs are likely to  
32 stimulate integration and coordination. Cross-cutting issues, such as environmental justice,  
33 need to be overtly part of those grants. Environmental justice is listed as a priority for the  
34 Administrator but is not specifically listed as a research program. More articulation of this  
35 priority is needed in the frameworks to ensure that it is not forgotten.

36  
37 Likewise, social, behavioral and decision sciences should be specifically articulated in both the  
38 Chemical Safety for Sustainability and Human Health Risk Assessment frameworks. For  
39 instance, in sections discussing risk assessment, it should be noted that research could provide  
40 some answers to the Agency’s understanding of how the public perceives “exposure” versus  
41 “contamination.” The Agency has spent a great deal of time and effort to get the technical  
42 science right, but if the public does not understand the basics of how the Agency makes its  
43 decisions and misunderstands concepts like “uncertainty,” the Agency will work against the  
44 very public it seeks to protect. The Human Health Research Assessment program may be able  
45 to foster greater public understanding of EPA risk assessment by adding new information to  
46 the Integrated Risk Information System process, for example, as recommended by the NRC  
47 2009 report *Science and Decisions* (e.g., by providing for public input into the design of a risk

assessment in its formative stages or by exploring how assessments can be used to evaluate the relative merits of various options for managing risk) to help people use the information in its products more effectively. The first step is to understand where citizens are with their thinking about chemical safety and risk assessment. The next steps are to address those gaps appropriately.

### ***Sustainability.***

The draft frameworks should clarify the use of the term sustainability and related terms. It would also be useful to develop a set of metrics that would be required elements to gauge if sustainability is attained (early markers of this long-term goal). Without metrics, resources may not be wisely allocated and the long-term goals missed completely.

### ***Ability to catalyze and complement environmental science programs outside EPA.***

EPA is a clear leader in the fields of environmental sciences – both in terms of technology development and in terms of research in a wide variety of fields that support the technology. For a variety of reasons, academia and industry have fallen behind and it is important for EPA to support and enhance current efforts. This could be enhanced with focused extramural grants on topics of translational or targeted science. In the area of toxicity testing, the National Center for Computational Toxicology (NCCT) has made a significant effort to develop collaborative and complementary efforts with other federal agencies (i.e., Tox21) and European partners (e.g., the Joint Research Center in Ispra). This level of effort and coordination needs to be extended to other ORD research endeavors.

ORD's research programs are generating novel scientific information that is not yet used in regulatory programs. Mechanisms need be developed to bridge this gap between ORD's innovative work of ORD and the scientific information actually used for decision making. This would include both the translation of this work into risk assessment as well as the incorporation of this work into guidelines employed by risk assessors. There should also be more coordination between the Chemical Safety for Sustainability program with programs such as Design for the Environment to enhance the activities of each.

The SAB and BOSC recommend that ORD explore mechanisms for industry-government collaboration. There are good examples of industry-government collaboration in Europe, Australia and New Zealand and this might be a useful model for the Agency to explore.

**Citations?** Identifying ways to reduce controversy between industry and government over individual risk assessments could possibly stimulate industry funding of toxicology research programs in academic institutions and strengthen the nation's overall environmental research capability.

### 3. Expanding ORD Capabilities in Social, Behavioral, and Decision Sciences

The SAB<sup>1</sup>, BOSC and other science advisory bodies<sup>2</sup> have over several decades repeatedly recommended expansion of social, behavioral and decision sciences expertise at EPA. To protect human health and the environment, the EPA has traditionally focused on risks from single pollutants in a single medium addressed through end-of-pipe technical controls and the specification of standards. As the focus has shifted to mixes of multiple-pollutants interacting through multiple environmental media to affect particular individuals and communities, new research is needed to support appropriate and effective policies. This research must, for example, address the impacts of human behavior on the production, use, dispersion and disposal of pollutant mixtures, variations in individual and community exposures and susceptibility to toxins, and impacts on the capacity of supporting ecosystems to absorb and transform toxins to less hazardous or even beneficial forms.

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<sup>1</sup> Recent advice related to social, behavioral, and decision science from the SAB

- *Science Advisory Board Comments on the President's Requested FY 2012 Research Budget* (EPA-SAB-11-007)
- *Office of Research and Development Strategic Research Directions and Integrated Transdisciplinary Research* (EPA-SAB-10-010);
- *Valuing the Protection of Ecological Systems and Services* (EPA-SAB-09-012);
- EPA's Strategic Research Directions 2008: An Advisory by the EPA Science Advisory Board (EPA-SAB-09-006);
- *Comments on EPA's Strategic Research Directions and Research Budget for FY 2008 - An Advisory Report of the U.S. Environmental Protection Agency Science Advisory Board* (EPA-SAB-07-004);
- *Science and Research Budgets for the U.S. Environmental Protection Agency for Fiscal Year 2007; An Advisory Report by the Science Advisory Board* (EPA-SAB-ADV-06-003);
- *Science and Research Budgets for the U.S. Environmental Protection Agency (EPA) for Fiscal Year 2006 - An Advisory Report by the EPA Science Advisory Board* (EPA-SAB-ADV-05-002);
- *Advisory Report on the Science and Research Budgets for the U.S. Environmental Protection Agency Fiscal Year 2005; A Report by the EPA Science Advisory Board* (EPA-SAB-ADV-04-003);
- *Toward Integrated Environmental Decision-Making* (EPA-SAB-EC-00-011)

<sup>2</sup> Selected National Research Council reports related to social, behavioral and decision science at EPA

- *New Directions in Climate Change Vulnerability, Impacts, and Adaptation Assessment: Summary of a Workshop* (2008) With effective climate change mitigation policies still under development, and with even the most aggressive proposals unable to halt climate change immediately, many decision makers are focusing unprecedented attention on the need for strategies to adapt to climate changes that are now unavoidable.
- *Population, Land Use, and Environment: Research Directions* (2005) reviews knowledge on interactions between demographic and environmental changes mediated by land use and recommends research directions.
- *Decision Making for the Environment: Social and Behavioral Science Research Priorities* (2005) identifies five areas of high priority research that can contribute to improved decisions affecting environmental quality.
- *Human Interactions with the Carbon Cycle: Summary of a Workshop* (2002) reports on discussions of promising research issues linking social science and natural science analyses of the carbon cycle.
- *Human Dimensions of Global Environmental Change: Research Pathways for the Next Decade* (1999) presents a state-of-the-field review and set of research imperatives.
- *Research Needs and Modes of Support for the Human Dimensions of Global Change* (1994) led NSF to support a collection of centers and research teams.

The SAB and BOSC review of ORD's draft 2011 research frameworks reinforces prior recommendations for expansion of ORD's social, behavioral, and decision science capabilities. The transformation of ORD to a transdisciplinary systems-oriented approach centered on sustainability requires a balanced program of research that integrates environmental (natural) sciences with economic and social sciences, and ORD capabilities in the last two areas continue to be grossly inadequate. Specific social, behavioral and decision scientists needs were identified for each of the individual program areas along with "cross-cutting" needs relevant to all program areas. The following summarizes SAB and BOSC responses to four key questions relating to social, behavioral and decision sciences in ORD:

1. What specific roles should social, behavioral and decision sciences fill in meeting science/decision support responsibilities relevant to the realigned ORD research programs (i.e., what might social, behavioral and decision scientists do)?
2. What specific sub-disciplines/fields of social, behavioral and decision sciences might best meet identified research and decision support needs?
3. Where might individuals having the relevant types of training, experience and expertise be found (e.g., what types of academic programs, research organizations, etc)?
4. How might social, behavioral and decision sciences best be organized and supported within the EPA/ORD research and development programs and systems?

### ***Specific roles social, behavioral and decision scientist might play in ORD***

At the broadest level two general roles were identified for social, behavioral and decision scientists. First, as addressed by the ORD/BOSC workshop on applications of decision sciences (March 2009), social, behavioral, and decision science principles and expertise could be used to improve the way ORD decides, plans and implements its own research activities. For example, social, behavioral, and decision science could be productively applied to elucidate and manage the often problematic boundary between science and policy and to identify and investigate alternative innovative ways to achieve policy goals. Second, social, behavioral, and decision science expertise is needed to support the various specific ORD research and decision support activities carried out within and across the six major program areas by systematically investigating individual, community and institutional values, perceptions, motivations, knowledge, beliefs and behaviors that affect, and are affected by, EPA efforts to protect human health and the environment.

There are numerous areas in which specific social, behavioral, and decision science research and expertise are needed. The most common areas for application of these sciences were:

- Perception/understanding of environmental risks and of mitigation alternatives, including awareness, knowledge and feelings associated with particular environmental risks and policy situations;



- Communication/education affecting understandings, feelings and actions relevant to protecting human health and the environment generally and for particular environmental policy contexts;
- Judgment and decision making, including both rational and emotional components;
- Behavior change for individuals, communities and institutions to foster and sustain support for agreed upon policy goals; and
- Values, motives and world views that discriminate among various constituencies/stakeholders and affect their preferences for and reactions to alternative environmental policies.

These potential roles for social, behavioral, and decision science capabilities research and application are quite consistent with and reinforce the conclusions arrived at independently by an ORD National Center for Environmental Research Behavioral/Social Science Town Hall held on June 7-8, 2011.

***Specific sub-disciplines/fields of social, behavioral and decision science that might best meet identified research and decision support needs***

Social, behavioral, and decision sciences encompass a large and diverse set of disciplines. Each major discipline includes many sub-disciplines and only a small portion of any social, behavioral, and decision science capabilities discipline is devoted to (or relevant to) the protection of human health and the environment as defined within the authorities and aspirations of EPA. Thus, ORD should be quite selective in recruiting the social, behavioral, and decision scientists to help meet the research and decision support needs identified above. Moreover, the social, behavioral and decision scientists must be capable of working effectively in a professional context that by tradition and by legislative authority emphasizes physical/chemical/biological sciences. The success of the ORD effort to effectively develop, integrate and nourish social, behavioral and decision science capabilities depends jointly on the general success of the transformation toward a truly transdisciplinary systems oriented research organization and on the selection of the individual social, behavioral and decision scientists who will enthusiastically join and effectively work within that organization.

A list of disciplines and sub-disciplines potentially appropriate to ORD social, behavioral and decision science needs is presented below in Table 1. This list is not comprehensive, but at the same time it is also too long to be of much use in actual recruitment efforts, especially given current constraints. The availability of scientists with relevant expertise and interests within each sub-discipline varies as does the current representation within ORD (ranging from none in most cases to a few in the case of economics, for example). Additional ORD interactions with the SAB and BOSC could help to extend, prune, refine and most importantly prioritize this list.

**Table 1: Initial list of relevant social, behavioral and decision science disciplines and sub-disciplines**

Discipline	Sub-disciplines
Psychology	environmental perception, pro-environmental behavior, risk perception, attitude assessment, attitude-behavior associations, environmental beliefs
Sociology	social impact analysis, diffusion of innovation, social networking, social capital assessment/development, social influence, compliance processes, community involvement
Decision sciences	judgment, decision making, value construction, deliberative group decision making, tradeoff identification/negotiation,
Communication	persuasive communications, science communication, strategic communications, public relations/affairs
Education	environmental education, environmental interpretation
Political science	public policy, environmental policy, institutional behavior, inter-governmental relations
Geography	hazard perception, environmental hazard mitigation, demographics,
Economics	applied economics, ecological economics, resource economics, agricultural economics, behavioral economics

***Where ORD might find scientists with the relevant types of training, experience, expertise and interests be found (e.g., what types of academic programs, government agencies, research organizations, etc)?***

There are social, behavioral and decision scientists working in many academic, government and private research and application contexts, any of which might be a productive source for filling ORD's needs. However, it is more likely that appropriate individuals will be found in interdisciplinary programs that specifically include collaborative education, research and applications related to environmental science and policy. Several federal agencies have considerably more experience with the development and use of social, behavioral and decision science, including the Department of Agriculture (notably the Agricultural Extension Service and the Forest Service) and the National Oceanic and Atmospheric Administration, which recently expanded and integrated social, behavioral and decision science into its Sea Grant program. Applied economics departments, integrated environmental science and policy/management programs, engineering programs that provide opportunities for minors in sustainability/social sciences/law, as well as the National Science Foundation-funded Integrated Graduate Education and Research Training (IGERT) programs are likely sources. A few specific programs (by no means a comprehensive list) that could be sources of relevant social, behavioral and decision scientists include Columbia University's Center for Research on Environmental Decisions (CRED), the Annenberg School of Communications at the University of Southern California, a program in behavior change theory at the University of Minnesota, and several programs at Carnegie Mellon University that allow natural scientists and engineers to add social science skills (or social scientists to add engineering or natural science skills). Several members suggested scanning the editorial boards and the authors publishing in relevant interdisciplinary

1 journals, including but not limited to *Journal of Environmental Psychology*, *Journal of*  
2 *Environmental Economics and Management*, *Society and Natural Resources*, *Journal of Risk*  
3 *and Uncertainty*, and *Risk Analysis* as a way to develop lists of potential individuals and  
4 institutions.

5  
6 ***How might social, behavioral and decision science best be organized and supported within***  
7 ***ORD?***  
8

9 There is a consensus that ORD must have some full time, in-house expertise in social,  
10 behavioral and decision science. At the very least, such individuals are needed to access and  
11 properly interpret existing social, behavioral and decision science principles and data relevant  
12 to ORD's mission, as well as to guide ORD toward the development of useful new social,  
13 behavioral and decision science information and science. The SAB and BOSC have little  
14 enthusiasm (or optimism) for the development of a separate social, behavioral and decision  
15 science program within ORD. The greatest consensus was for a cross-cutting organization,  
16 with social, behavioral and decision science supported within each of the major programs.  
17 Several members suggested that there should be at least one social, behavioral and decision  
18 scientist at a relatively senior level in each of the six ORD research program areas. These  
19 individuals would be charged with directing social, behavioral and decision science activities  
20 in their assigned program and work regularly with the social, behavioral and decision scientists  
21 in other programs to coordinate social, behavioral and decision science activities across ORD.  
22 To effectively integrate social, behavioral and decision science in the realigned ORD research  
23 programs, social scientists will need to be involved in problem formulation and in the design,  
24 development and implementation of all research and decision support efforts. Several members  
25 also voiced concern that ORD must address the needs for a "critical mass" and for physical  
26 proximity and effective communication among the social, behavioral and decision scientists.  
27 Performance evaluation and reward programs should recognize the special cross-cutting roles  
28 of social, behavioral and decision scientists.

29  
30 Additional social, behavioral and decision scientists for specific projects could be recruited  
31 through post doctoral appointments and, at a more senior level, through targeted sabbatical  
32 leave support and/or special government employee programs or other visiting or temporary  
33 appointment procedures. For longer-term development of social, behavioral and decision  
34 science capacity directly relevant to EPA, ORD should increase its support of relevant extra-  
35 mural social, behavioral and decision science research grants and other programs that  
36 encourage development of educational programs that provide skills and experiences needed by  
37 social, behavioral and decision scientists who might work in the EPA context.

38  
39 It was generally assumed, and generally supported, that ORD should develop and shape its  
40 social, behavioral and decision science capabilities over time, learning as it goes about EPA's  
41 greatest social, behavioral, and decision science needs are and how best to fill them. At the  
42 same time, consensus was very strong that this process needs to start now! Members of the  
43 SAB and the BOSC expressed a strong interest and willingness to assist ORD in meeting  
44 social, behavioral and decision science needs that have been apparent for some time.  
45

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